UTM
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SCHOOL OF COMPUTING
Faculty of Engineering

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SUBJECT :

TECHNOLOGY AND INFORMATION SYSTEMS (SECP1513)

SECTION :

10

TASK :

PROJECT - LOW FIDELITY PROTOTYPE PART 1

GROUP :

7

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INTRODUCTION

A prototype is a sketched draft that allows us to explore our ideas and show the concept of design to users before investing time and money into development. A prototype can be anything from paper drawings that are low-fidelity to something that can lead to a fully functioning site that is high-fidelity.

Low-fidelity prototypes are usually based on paper and do not allow interactions between users. They range from a series of hand-drawn models to printouts and the creation period of low-fidelity sketches is higher. Low-fidelity prototypes are useful as they can enable early visualization of different design solutions which helps stimulate innovation and improvement. Besides, users may find it more comfortable to suggest changes while using rough sketches. Using low-fidelity prototypes can also help to get more honest and better feedbacks, so the cost of errors will become cheaper. Examples of low-fidelity web and mobile prototyping are sketches for the website, website UI, wireframes, camera timer and others.

Our low-fidelity prototype project will be based on the Fourth Industry Revolution (IR4.0) technologies which is The Internet of Things (IoT). The IoT that we choose is Smart Home. We will create a case study from a viewpoint of an imaginary client that can provide input and problem scenarios for the project. In this project, we propose to use Cloud Architecture which refers to different components in terms of databases, software capabilities, applications and so on.

SELECTION OF 4TH IR TECHNOLOGY

Internet of Things (IoT)

The technology we selected is IoT. IoT is a system of physical gadgets implanted with sensors, software, control systems, electronics, and connectivity. An IoT system includes data collection, data collation and transportation, and information analysis and action. Sensors, antennas, and microcontrollers are examples of devices used to collect data. The data is then relocated to the IoT hub or IoT gateway. After processing the raw data, the analyzed data will be transferred to the user interface like smartphone, human-machine, or the analytics of business application, or to the back-end systems. Customers will act after receiving the analyzed data.

IoT allows improved collection and exchange of information with other connected devices, operators, or manufacturers to improve the quality of human life. Examples of IoT applications are home security (smart home), activity tracker, Augmented Reality (AR) glasses, and industrial Internet. Among them, we chose smart home to produce a low-fidelity prototype.

Smart Home

People in this 21st century are pursuing speed for every single thing. The continuous technology development generated many devices such as smartphones, smart camera, smart television, smart refrigerator, smart air conditioner, and smart cooker. The electronic appliances in a smart home are automated and implanted with a sensor system and control system. The sensor will detect the condition of the surroundings, and the electronic devices will receive the command from the control system to make changes. The electronic appliances are connected to Wi-Fi or other wireless connections and can be monitored long-distance by using the smartphone.

Smart home is used widely because it makes our life more efficient. We can cook meals, turn on air conditioners, control the lightning, water plants, and detect leakage of pipes by just using an app. A smartphone application or a web-based page is the approach to produce software for smart home devices. The users use the software to monitor their houses and apply instructions to the devices. Therefore, the user interface must be user friendly and reliable to secure the user's experience. Smart home software nowadays is still lacking in some aspects. So, we want to develop a low fidelity prototype of smart home software that can satisfy most users.

CLIENT

Name: Lonny Jodocus

Position: Software Engineer

Company: VYROX

Problem:

VYROX is the best IoT smart home system provider in Malaysia and top 10 IoT smart home system integration company in South-East Asia [1]. VYROX is planning to develop an application for their newest smart home system. The problems of their previous application are it takes a lot of steps and times to install a new smart device. Besides, previous application cannot connect to some of the other brands' smart devices. Furthermore, the old application had complex navigation and settings that confuses the users a lot. Finally, a lot of users complain that there were too many advertisements in the old application.

ARCHITECTURE PLANNING AND DESIGN

Solution:

The client, VYROX is a smart home system provider. We develop a new IoT infrastructure so that their application can shorten the time and decrease the steps to install new smart devices to the cloud. Besides, the new system aims to remote more different brands of smart devices. The navigation and settings also will be simplified and provide a better user interface. Lastly, the application also demands higher security to prevent the spam of advertisements that affect the user experience.

System Architecture for Smart Home

We aim to build a **multi-purpose solution** that enables many devices implicated into a single system, that allow users to remote devices from varied manufacturers. Hence the users are free to choose the smart devices they prefer and provide better user experiences.

Diagram 1 illustrates the system architecture for Smart Home.

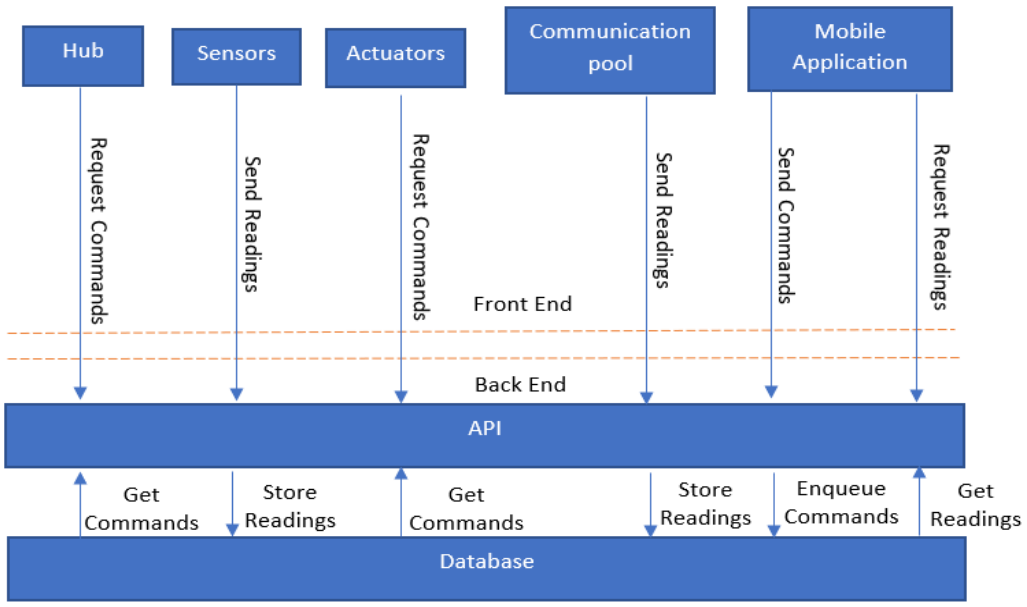

Diagram 1

Major component in a smart home system

1. **Hub**

   Hub is the brain of the smart home system. It is the main controller and it manages the data process and transfers data between the smart devices with the automation system.

A hub consists of a back end and a client-side infrastructure which is mobile apps that the users can use to remote the devices at any place with the Internet.

2. **Sensors**

   Sensors are the devices used to detect changes to environmental conditions such as temperature, movement, humidity, leaks, or brightness. Sensors usually transfer the information directly to the hub and the hub decided the actions with this information. Sensors only gather the information and do not take any actions.

3. **Actuators**

   Actuators are smart devices that follow the commands from the hub and act. Actuators include all the IoT devices such as smart TV, speakers, automatic blinds, thermostats, etc.

4. **Communication protocol**

   The communication protocol enables the smart devices to connect to a hub. Examples of communication protocols are Wi-Fi, Bluetooth, Z-Wave and Zigbee. With different connectivity, you can access your devices at different distances. Wi-Fi is the most common and powerful connection used because the users can manage their devices anywhere through the Internet.

5. **Database**

   Database stores the data obtained from the sensors and Cloud services, and acts as command backlog to be sent to actuators.

6. **Server/ API layer between the front end and the back end**

   Server receives commands from the mobile application users to operate the actuators and stores the commands in database. The actuators make requests to carry out the commands stored in the database through the server.

7. **Mobile application**

   Mobile apps act as the user interface which enable the users to observe and control their home devices.

Cloud Architecture of Smart Home Application

It is difficult for us to create the back end system by ourselves, so we choose **Amazon Web Services** to aid us in the production of the new smart home application. The three main components of a smart home system are the front end (client's infrastructure), the Internet, and the back end (databases, cloud storage, etc.) in AWS Web Services. The back end handles many things starting from registration, sign in, charging to more complicated administering tasks like processing the data received into a command or generating notification to the users. All the smart devices such as air conditioners, coffee brewers and TV are installed with AWS IoT Greengrass, to access the smart home back end system. AWS IoT Core is the control service that enables the interconnection of end-users and the home devices connected to this platform.

Diagram 2 exemplifies cloud back end system for smart home application adopted from [2].

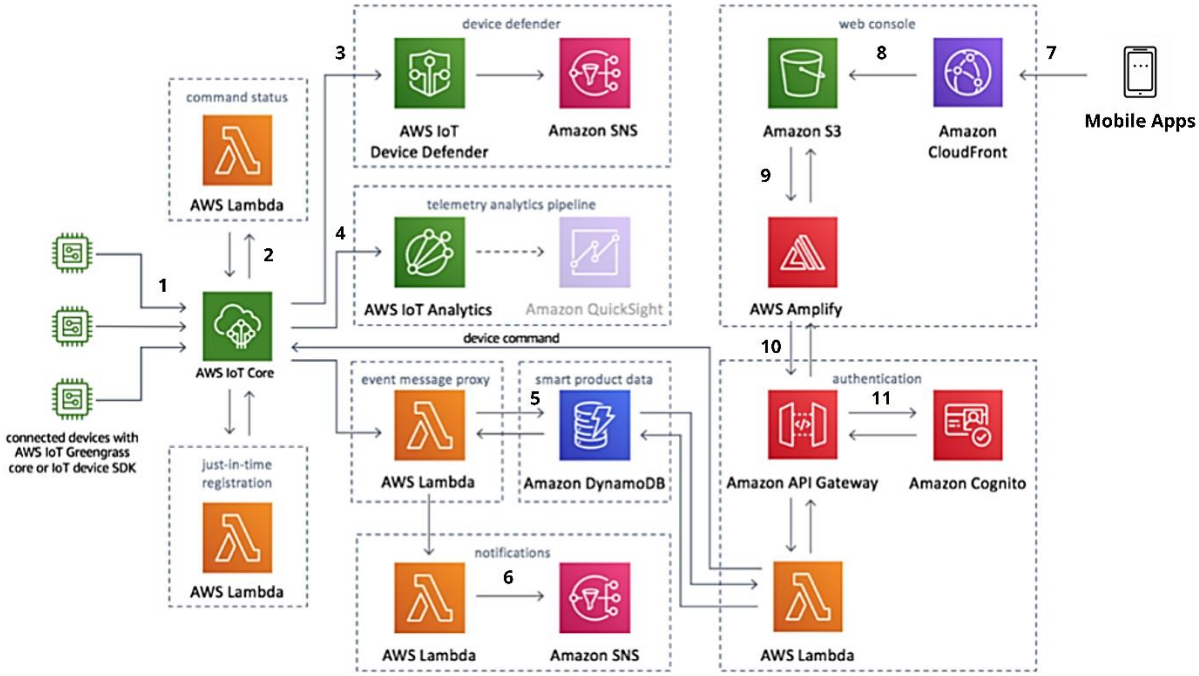

Diagram 2

1. **AWS IoT Core** permits the connection of the devices to the cloud. IoT Core transmits and receives updates based on the data accepted [3]. The devices are connected with AWS IoT Greengrass core or IoT device SDK to gain access to AWS IoT Core.
2. AWS IoT Core uses a rule engine to extract necessary data from the messages and routes the info to the solution's microservices (**AWS Lambda** functions) to operate.

3. **AWS IoT Device Defender** always examine your devices to make sure they do not diverge from best security practices [4]. If there are any security problems, it will generate a notification and send it to the users through Amazon Simple Notification Service (**Amazon SNS**).
4. AWS Core IoT transfer the raw data received to **AWS IoT Analytics**. AWS IoT Analytics functions to analyse data received from the IoT devices and generate more precise orders for IoT devices. AWS IoT Analytics pre-programmed every complicated step needed to analyse data obtained from IoT devices.
5. **Amazon DynamoDB** function as the document database that stores numerous orders about the smart products, back up the data and cached the commands in the queue to be executed.
6. **Amazon SNS** distribute messages from smart devices to mobile application users.
7. **Amazon CloudFront** lets users access Amazon S3 and receive data, videos, applications, and APIs. The front end mobile apps users can monitor their house condition through the Amazon CloudFront.
8. Amazon Simple Storage Service (**Amazon S3**) store and protect the mobile application users data.
9. **AWS Amplify** is used to create the front end user interface (UI).
10. **Amazon API Gateway** hosts the authentication of the identity of users to access the control. Amazon API Gateway receives commands from front end mobile apps users and triggers the AWS Lambda function to fulfil the requests.
11. **Amazon Cognito** adds user sign up, log in, and enable the users of the mobile apps to access the control of the smart devices.

CONCLUSION

All things considered, we select the IoT Smart Home as 4th IR Technology because it is one of the most convenient software that functions to monitor or control the electronic devices in our house in a long-distance by just using a smartphone application. In this low-fidelity prototype, we create a case study to find out the problems that occur in the current Smart Home software.

Through the case study of the potential client, which is the VYROX Smart Home application, we found that there are a few problems that had brought some inconveniences for the users in the application. The application has to be upgraded to a new version that has a simpler user interface and is easier to configure the smart devices.

In the architecture planning and design, we decide to build a multi-purpose solution that enables many devices implicated into one system. After we consider the main component and elements of the smart home system and the basic features of the smart home mobile application, we choose Amazon Web Services to support our production of the smart home application. AWS IoT for smart home systems helps us in voice enablement and home automation, home security and monitoring, and also home network management.

To sum up, the prototype that we created successfully solved some of our problems, but there are still some problems that we cannot completely solve. For example, the time required to install the application and the speed of running the smart device. Because of our limitations, we are still not professional and experienced enough to produce a perfect low-fidelity prototype. However, there is also our contribution to the 4th IR Technology, which is the brand-new design of the prototype created by our group. Our low-fidelity prototype allows users to control the devices from different manufacturers. Thus, device users can freely choose their favourite smart devices to provide a better user experience.

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